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PHYSICS.—*Studies on the silver voltameter.*[1] G. A. HULETT and G. W. VINAL, Bureau of Standards.

A comparison has been made of the silver voltameters and methods employed at the Bureau of Standards with the voltameters and methods used at Princeton University. For the details of the previous work at these two institutions reference is made to the Bureau of Standards Bulletin, **9**, 151, 209, 493; **10**, 475, and the Transactions of American Electrochemical Society, **12**, 257; **22**, 367. All the experimental data recorded in this paper were obtained in the laboratory of Physical Chemistry of Princeton University.

A preliminary comparison of the voltameters, using the same electrolyte in all, showed a consistent difference of one part in ten thousand, the Bureau voltameters having the greater deposit. A systematic search for the cause of this difference showed it to be due to two factors, viz., the differences in the methods of preparing the porous cups and, second, the differences in the method of washing the deposit.

The Bureau's porous cups were kept in silver nitrate between experiments and produced little change of acidity in the electrolyte of the voltameter, but the Princeton porous cups were usually washed free from the silver nitrate after each experiment and kept in distilled water. It was found in this case that the acidity of the voltameter electrolyte increased. The fact that the Bureau's porous cups were made by a different maker than for the Princeton cups was without significance since when the

[1] Detailed paper to appear in full in the Bulletin of the Bureau of Standards.

two different kinds were kept saturated with silver nitrate they produced identical results.

The practice of nearly all observers has been to continue the washing of the deposit until the presence of silver nitrate can no longer be detected in the wash waters by chemical tests, but many have taken the further precaution of allowing distilled water to stand on the deposit for a considerable period of time. As a test on the completeness of the washing, we compared the conductivity of the water before being put in the cup with its conductivity after it has stood in the cup for various periods of time. In every case the conductivity increased with time. It was at first supposed that this increase was due to entrapped silver nitrate gradually soaking out, as we could detect the silver in the water after allowing to it stand overnight. All subsequent experiments, for which reference is made to the complete paper, showed that this is not the case, but rather that an electrolytic process was taking place by which the silver was passing into solution at the rate of about 0.006 mg. per hour from a 4 gram deposit of silver on platinum. To confirm this we were able to show by a galvanometer that a current actually passed from the silver through the water to the platinum. In washing the deposits overnight, this effect becomes appreciable. The work was closed with a final comparison of the voltameters in the light of our experiments and unusually good agreement found.

PHYSICS.—*A simple method for the accurate measurement of relative strain in glass.* FRED. E. WRIGHT, Geophysical Laboratory.

The phenomena attendant upon strain in glass have long interested physicists and glass-makers, and much time has been spent in the investigation of the different phases of this subject. The optical effects resulting from strain were first studied in detail by Brewster[1] at a time when only the simplest of optical apparatus was available and but little was known of double refraction. Notwithstanding this, Brewster deduced from a

[1] Philos. Trans. 1814, 1815, 1816.

series of ingenious experiments many of the fundamental laws of the optical behavior of glass strained either mechanically by differential pressure or tension, or as a result of non-uniform heating or cooling. Brewster found: that a plate of glass under load is birefracting; that the optical effect produced is sensibly proportional to the intensity of the strain; that a plate of glass under differential compression behaves optically as a uniaxial negative crystal with its principal axis in the direction of the acting load, while under differential tension it acts as an optically positive uniaxial crystal; that in a glass plate cooled quickly from a high temperature a permanent strain is imparted which is at maximum intensity next to the outer surfaces (zone of compression), and which, decreasing toward the center, reaches a neutral band and passes then into a zone of tension in the central part of the plate; that compression produces retardation, while dilatation causes acceleration of the transmitted light waves, with the result that a rapidly cooled cylindrical rod of glass with plane parallel end surfaces behaves as a negative lens (meniscus).

Following Brewster, Fresnel[2] proved definitely that two waves are transmitted through a strained glass plate; F. E. Neumann[3] gave a mathematical solution of the general problem on the basis of certain assumptions; A. Wertheim[4] verified Brewster's statement of the proportionality between optical effect and intensity of strain; Macé de Lépinay[5] found that the path difference is practically the same for all wave lengths and that, therefore, the interference colors are essentially those of Newton's color scale. J. Kerr[6] proved, by means of a Jamin interference-refractor, that in the case of compression both waves are retarded while in the case of tension both waves are accelerated; that the wave whose vibrations take place in the plane normal to the direction of the applied load is retarded most, its retardation being practically twice that of the wave vibrating along the direction of strain; that "the action of directionally strained glass, in the common

[2] Oeuvres Completes.
[3] Pogg. Ann. **54.** 1841.
[4] Comptes Rendus, **32, 33, 34.** 1854.
[5] Ann. d. Chim. et Phys., **19:** 1–90. 1880.
[6] J. Kerr, Phil. Mag., (5), **36:** 321. 1886.

polariscope, upon light crossing the line of strain at right angles is due exclusively to strain-generated change of velocity of the component ray which has its plane of polarization parallel to the line of strain;" that in the case of plates cut parallel with, or normal to the direction of strain, the difference of retardation for obliquely incident rays varies directly as the cosine of the angle of refraction. This relation, in particular, indicates how closely similar in its optical behavior a strained glass plate is to a uniaxial mineral. S. Czapski[7] measured the relative strain in glass rods by a dioptric method based on Brewster's observation that a cylindrical rod behaves optically as a meniscus lens. F. Pockels[8] studied, by means of a Jamin interferential refractor and a Babinet compensator, the optical effects produced in a glass plate by elastic deformation of given magnitude. He found also that a lead silicate glass high in lead shows anomalous optical behavior in that it acts under load as an optically positive substance; also that for each color of light there is a composition of lead silicate glass for which no optical effect is produced either by compression or dilatation. Recently E. Zschimmer and H. Schultz[9] have investigated, by means of a Babinet compensator in combination with an interference method based on Lummer's theory of interference curves of equal inclination, the optical behavior of glass heated and cooled under different conditions. Their method, like that of Czapski, is so applied that it furnishes an average or integration value of the relative retardation of the waves after transmission through any particular part of the plate. The method is well adapted for the purpose but the apparatus is complicated and its manipulation evidently requires a considerable degree of skill.

It is of interest to note that in practically every paper cited above a new method is proposed for measuring the optical effects observed. A careful study of these and other papers and also of the general theory of the thermal behavior of cooling glass plates indicates clearly that further progress in this interesting and technically important field depends chiefly on careful quanti-

[7] Ann. d. Phys., **42**: 319–331. 1889.
[8] Ann. d. Phys., **7**: 745–771. 1902; **9**: 220–223. 1902.
[9] Ann. d. Phys., (4), **42**: 345–396. 1913.

tative measurements and that therefore a simple method for measuring relative optical retardations accurately should be of value. The method presented below is suggested for this purpose. In this method the glass plate is examined in strong monochromatic light between crossed nicols; the path difference of the emergent light waves at any given point is measured by means of a bi-quartz compensator of special type.[10]

The most satisfactory source of monochromatic light available is the green line (546 $\mu\mu$) of a strong mercury lamp, as viewed

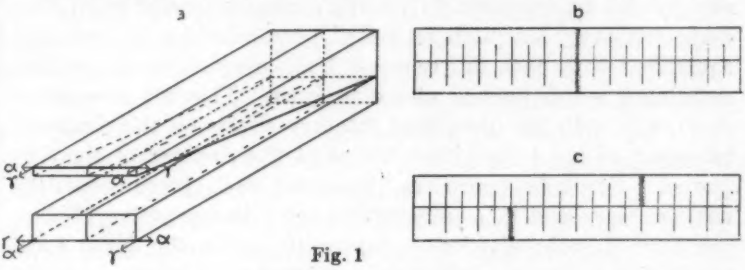


Fig. 1

through a Wratten and Wainwright special filter No. 77. The rays from the lamp are rendered parallel by means of a condenser lens before entering the polarizer. For certain purposes direct sunlight or an arc light may be used and gives results which are sufficiently accurate.

The bi-quartz compensator consists of two quartz plates and two quartz wedges cut parallel to the principal axis and mounted as indicated in figure 1 a. When viewed in the diagonal position under crossed nicols this wedge presents the phenomenon of figure 1 b, namely a dark, transverse band of exact compensation, on both sides of which the interference colors rise to gray, or other color of the first or higher order depending on the pitch and length of the wedge. The wedge is so ground that graduations on the upper surface of the compensator indicate directly the path differences in $\mu\mu$ for the wave length (546$\mu\mu$) of light employed. As indicated in figure 1 the bi-compensator is so

[10] F. E. Wright, Amer. Jour. Sci., (4), **26**: 370-371. 1908; Carnegie Institution of Washington, Publication 158: 134-135. 1911.

constructed that the optical elongations of the two halves are equal but of opposite sign, the result being that on the insertion of a birefracting plate in the diagonal position the dark band in the one-half moves to the right while in the second it moves to the left as indicated in figure 1 c. With a properly constructed bi-compensator the shift produced by a path difference of less than $1\mu\mu$ can be readily detected and measured. The sensitiveness of the combination wedge varies inversely with the pitch of the wedge. The most favorable conditions for observation are: intense illumination by parallel, monochromatic rays; long wedge with very low pitch, such that 1 scale division (0.1 mm.) is equivalent to a path difference of 1 $\mu\mu$; magnifying system for examining wedge located above analyser. This last precaution does away with the disturbing rotatory effects on the planes of vibration of the transmitted waves at the surfaces of the lens system. For most purposes, however, such precautions are not necessary and it is sufficient to use a less sensitive bi-compensator (1 scale division = $5\mu\mu$ or 10 $\mu\mu$) in the lower focal plane of a positive eyepiece in a petrographic microscope, the analyser then to be a cap-nicol.

The conversion of the optical retardations thus measured on a given piece of glass to the corresponding elastic deformation data is accomplished by direct measurements on the glass subjected to a series of mechanical loads of known magnitudes.

The above optical method for measuring relative strain in glass has been employed for several years in practical glass work and has been found to be satisfactory.[11] In certain instances details of the method require modification to meet best the special conditions of measurement, but such adaptations are readily made and the general underlying principles remain unchanged.

MINERALOGY.—*Additional notes on babingtonite from Passaic County, New Jersey.* CLARENCE N. FENNER, Geophysical Laboratory.

In the November 19th issue of this JOURNAL the writer described an occurrence of the mineral babingtonite in the deposits

[11] R. L. Frink, Eighth International Congress of Applied Chemistry, **5**: 13. 1912.

of zeolitic minerals found at various localities in the Watchung basalt sheets of northern New Jersey. Mention was made of the presence of certain remarkable cavities or casts of some mineral formerly present, which are very abundant in the deposits and which have been a source of much speculation among mineralogists for many years. It was believed that the evidence indicated that the origin of the casts was to be ascribed to babingtonite. Since the article was written certain new evidence has come to light which has an important bearing upon the subject.

Through the kindness of Dr. W. T. Schaller of the United States Geological Survey my attention has been directed to two recent discoveries. One of these was reported in an article in the New York *Times* for November 23, in which Mr. F. I. Allen of New York described the discovery of anhydrite at West Paterson and ascribed to this the rôle of the parent mineral of the casts. At about the same time or a little before, an unpublished discovery was made at McKiernan and Bergin's quarry in Paterson of pseudomorphs of quartz occupying certain of the cavities. These pseudomorphs were remarkable for the fact that they were loose in the cavities and could be easily withdrawn, but nevertheless showed sharply defined prismatic faces and less distinct terminal faces. The presence of these faces suggested that a comparison of the crystal angles with those of known species might serve to establish the identity of the original mineral.

Since the appearance of the previous article I have received a number of inquiries regarding the occurrence of babingtonite from mineralogists who have been interested in the casts, and some question has been raised as to the quantitative importance of this mineral in the formation of the cavities. Its identification as babingtonite appears to have been accepted, but some doubt has been expressed as to whether it was present in large amount and as to whether most of the cavities should not rather be ascribed to anhydrite and a possible third mineral of unknown nature. For these reasons and on account of the importance of the new finds it seemed desirable to revisit the localities of discovery, to examine all available material, and to present a

summary of the evidence which has come to view in its bearing upon the question of the identity of the original mineral or minerals of the cavities. Accordingly several days have been devoted to visits to the New Jersey localities where the minerals and casts have been found and to the collection of material for examination. Considerable new evidence has been brought to light and will be presented here.

One of the chief points upon which information was considered desirable was the question of the relative importance and abundance of the two minerals babingtonite and anhydrite. It was found that the quantity of anhydrite so far discovered was very small and that no new material had been opened up since that which Mr. Allen described. However, through the kindness of Mr. Allen and of another collector, Mr. Lovell, of Paterson, the opportunity was given to examine several specimens. The anhydrite occurs in large crystals in a quartz matrix and there seems to be no reason to doubt that it is of primary origin and does not simply fill cavities left by the removal of some other substance. In the specimens seen it occurs either in simple crystals of nearly square section or in slightly radiating or fan-like crystals produced by a spreading-out in the direction of one of the axes. Careful examination failed to show any indication of laminae of quartz projecting from the walls into the anhydrite. On the contrary the walls of the matrix appeared to be perfectly straight and smooth and differed in that respect from those of most of the rectangular casts. However, it does not seem unlikely that under certain conditions of decomposition and removal of the anhydrite such laminae might be built up along the cleavage planes. The evidence appears quite clear that anhydrite was the original mineral of some of the rectangular cavities, but the later investigation has strengthened the belief that babingtonite also was an abundant and important mineral and that certain of the casts left by its crystals are of such size and form that they present a remarkable resemblance to those due to anhydrite.

From a search among the minerals of West Paterson and Great Notch it has been found that babingtonite is less rare than had

been supposed. Small remnants have been discovered on numerous specimens (about two dozen in all have been obtained) and its mode of occurrence is frequently such as to strengthen the view regarding its relationship to the casts. In many instances it is plain that the small fragments seen are survivals of larger crystals. As a general rule the babingtonite is covered with decomposition products, either the asbestos-like substance mentioned in the preceding paper, or a green material, probably of chloritic nature, or, less frequently, red hematite. In general the greater part of the crystals has been removed and only the impressions are left, but by directing a search among the terminations of the cavities, where thin laminae of other minerals projected into the original crystals, babingtonite has been found so frequently as to leave little doubt that it represents portions of the original crystals surviving because of their protected situation. In another form of occurrence the relations are such as to show that it is not of secondary deposition. Broad faces of casts have been found, on which patches of babingtonite are seen, and from other portions of the surfaces small projections of the mineral run directly into the matrix. The relations indicate that large crystals, which have been subsequently dissolved away, carried small offshoots, which have been protected by the matrix. The characteristics are those which have been observed in several crystal groups of babingtonite which are in a better state of preservation than usual.

From a study of the specimens in which these relations have been found it is possible to arrive at certain conclusions regarding the nature of the casts which are due to babingtonite.

In its simplest form the mineral has developed in small, thin blades, extending like gashes into other minerals. These may be single crystals or may form groups growing together without apparent order. At times such groups show two or three crystals of larger development, with small offshoots in various directions. With increasing size the crystals, as inferred from the cavities, have tended to assume rectangular forms, but with one dimension still much less than the other two. In places the impressions of these tabular crystals extend over a wide surface, often in a

somewhat fan-like form. A specimen of pectolite showing the impression of flattened crystals of this kind, and with numerous small offshoots of babingtonite running into the matrix, gave measurements of 4 x 5 cm. On the same specimen another impression with essentially similar characteristics measured 2½ x 5 cm. and showed a thickness of 0.5 cm. An impression on quartz, with remnants of babingtonite among the laminae, measured 7 x 1 x 0.5 cm., and another, likewise showing babingtonite, gave 7 x 3.5 x 0.3 cm. In another mode of development the width and thickness of the cavities do not differ greatly from each other and the crystals appear to have had a simple prismatic form, whose cross-section was essentially rectangular. A certain specimen which shows this type is composed of an aggregate of prehnite crystals in a finger-like form, which now surround a rectangular cavity running through the middle of the group. The original crystal is inferred to have been babingtonite because of the discovery of this material among the laminae projecting from one of the surfaces of the orifice. The dimensions of the cavity are 5 x 0.8 x 0.5 cm.

These measurements indicate that the crystals of babingtonite attained large dimensions. Some may have been considerably larger than the measurements given, as similar cavities of larger size are not infrequent, but only those have been cited in which the presence of babingtonite has been detected.

If, in cavities of this character, babingtonite had been discovered in two or three specimens only, its presence might perhaps be explained in other ways than under the supposition that it represented the remnants of the crystals which filled the cavities, but it has been found in repeated instances in the situations where it was looked for and where it might be expected to resist for the longest time the solvent action of circulating waters, and its presence can hardly be regarded as fortuitous.

In practically all specimens in which babingtonite has been found in the cavities thin laminae, projecting from the walls and lying parallel to the widest surfaces, are a marked characteristic, and such cavities are very abundant. In certain other cavities the walls are either smooth or show ridges of some-

what different appearance from that presented by the extremely thin laminae. In still others a cell-like structure of rectangular partitions has been built across the cavities. In such types anhydrite may have been the original filling, but no trace of either mineral has been detected in them.

The formation of the laminae and ridges and partitions seems best referable to the action of solvents upon planes of easy solution in the crystal structure, with the simultaneous deposition of other minerals. Such solution-planes would most likely correspond to cleavage-planes, although not necessarily so. Anhydrite, as is well known, has three easy cleavages at right angles to each other. According to Dana and Hintze, babingtonite has but two cleavages, which are parallel to 001 and 010 and include an angle of 92° 36′, but it has been found by examination of small cleavage-fragments under the microscope that in reality four are probably present. Three of these make angles with each other which do not differ appreciably from 90°. These cleavages have been observed both in the New Jersey mineral and in National Museum specimens from Italy and Norway. Therefore it does not appear practicable at present to differentiate the casts on the basis of rectangular parting-laminae.

In these approximately rectangular cavities the babingtonite crystals appear to have been of prismatic or tabular habit, with a terminal plane cutting the other two at nearly right angles. It cannot be stated definitely which crystal-faces are represented, but, as suggested in the former paper, Dauber's $g$ $(2\bar{1}0)$, $h$ (110), and $c$ (001) appear probable forms. These are figured by Hintze as faces of prominent development in babingtonite from Arendal and Herbornseelbach and the included angles differ only slightly from 90°. Crystals bounded by these three planes are of simpler form than babingtonite ordinarily shows, but, considering the well-known variations in this respect which many species exhibit, this does not appear of serious importance.

Thus far the casts of rectangular form only have been treated in this article, and it remains to consider those of lozenge-shaped cross-section. The latter are also of frequent occurrence in the deposits and are often associated with those of rectangular de-

velopment. It is rather remarkable that, whereas the rectangular casts are found in various minerals—quartz, prehnite, pectolite, datolite, albite—the lozenge-shaped casts have been observed in quartz only, and no other minerals have been noticed in close association (except possibly such as are of later origin). This naturally implies a difference in conditions of deposition in the two cases.

In the previous paper the lozenge-shaped cavities were regarded as due to babingtonite. Since then little new evidence has been found which either confirms or disproves this view, but one fact on which the conclusion was in part based has been found to have less force than had been supposed. It had been observed that cross-sections of the babingtonite crystals first discovered exhibited lozenge-shaped boundaries, and in the new material likewise this is frequently true, but careful examination raises a doubt as to whether this is not a result of the manner in which weathering has attacked the crystals. It seems probable, in fact, that, in some cases, decomposition has acted in a peculiar manner upon the crystal-surfaces and has tended to produce lozenge-shaped forms from originally rectangular crystals. Less weight, therefore, is now attached to this evidence.

On the other hand, the measurements of the angles of the cavities which were cited show very close agreement with the crystal angle between the faces $b$ (010) and $g$ ($2\bar{1}0$) of babingtonite.

A number of the quartz pseudomorphs from McKiernan and Bergin's quarry have been obtained and a series of new measurements has been made with a contact goniometer. Some of these specimens were kindly loaned by Professor Palache of Harvard University and by Mr. Lovell of Paterson, and others were secured from the foreman of the quarry. Although these pseudomorphs show sharp prismatic angles there was less agreement among the measurements than had been expected. The average of 56 measurements gave $61\frac{1}{3}°$, but there were variations ranging from $57\frac{1}{2}$ to $66\frac{1}{2}°$, and the two extremities of the same pseudomorph frequently showed a marked difference.

The terminal faces of the specimens were small and much less well-defined than the prismatic faces, and the angles were not

measured. They appear to indicate monoclinic or triclinic symmetry, but do not suggest the forms of babingtonite which are figured by Hintze and Dana. Differences in conditions of deposition, however, might cause much variation in this respect. Some indication of the former presence of a ferriferous mineral is afforded by the frequency with which these casts are stained red by ferric oxide or are partially occupied by a chloritic substance.

The conclusions which have been reached regarding the various forms of cavities from a study of the new material and a re-examination of all the available evidence may be summarized as follows: Both babingtonite and anhydrite were undoubtedly present in the deposits and the crystals of each attained a large size. In some instances the geometric form of the two was so similar that the nature of the original mineral cannot be decided from the casts alone. Babingtonite, however, seems to have shown a tendency to develop in a rather tabular shape, and cavities of this kind, especially when showing the projection of many thin laminae, are regarded as more probably due to the latter mineral. The rectangular cavities both of tabular and of nearly square form seem sufficiently explained by the discovery of these two minerals

The origin of the lozenge-shaped cavities is more uncertain. They may have been occupied by babingtonite deposited under different conditions from those which prevailed during the deposition of the rectangular forms and therefore developing different crystal-faces, or they may be due to some other mineral to whose nature we have little clue. It seems necessary to obtain more information before reaching a positive conclusion on this point.

# ABSTRACTS

**Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.**

GEOCHEMISTRY.—*Water analyses from the laboratory of the U. S. Geological Survey.* F. W. CLARKE. U. S. Geological Survey, Water-Supply Paper, 364. Pp. 40. 1914.

This paper is a compilation of 203 analyses of river, lake, spring, well and mine waters made by the chemists of the Geological Survey. Among them are included the important series of analyses of waters from the Yellowstone National Park, originally published in Bull. 47.

F. W. C.

GEOCHEMISTRY.—*Quality of the surface waters of Washington.* WALTON VAN WINKLE. U. S. Geological Survey Water-Supply Paper 339. Pp. 105. 1914. (Prepared in cooperation with the State Board of Health of Washington).

Serial analyses of water collected for a year at 17 stations on the principal rivers of Washington are reported and discussed in connection with geologic, climatic, and economic conditions. The streams are low in mineral content and excellent for general industrial use and irrigation, being comparable in quality to the extremely soft waters of New England. All the waters belong to the calcium carbonate types, the content of sulphate is not large, and chlorine is very low. The water of Columbia River was under study for two years at Cascade Locks, the lowest sampling point above tide-water. The stream ranges from 68 to 129 parts per million of dissolved solids and averages 94 parts with a hardness of 58 parts. It carries an average of only 26 parts per million of suspended matter; calculations show that it is denuding its drainage basin at a rate of 100 to 150 tons of rock material per square mile per annum.

R. B. DOLE.

GEOCHEMISTRY.—*Quality of the surface waters of Oregon.* WALTON VAN WINKLE. U. S. Geological Survey Water-Supply Paper 363. Pp. 1137 1914. (Prepared in cooperation with the state of Oregon, JOHN H. LEWIS, State Engineer.)

This document embodies the results of the first comprehensive study of the quality of the surface waters of Oregon and reports serial analyses of water from 20 stations on the principal rivers with a discussion of the analyses in relation to conditions of geology, climate, and economic development. The investigations of the composition of saline lake waters in southeastern Oregon indicate that the commercial recovery of soda salts from few of them is practicable. Most of the streams within the State drain regions of basalts and other effusives, and consequently carry relatively little mineral matter in solution.

R. B. DOLE.

GEOCHEMISTRY.—*The constitution of the natural silicates.* FRANK WIGGLESWORTH CLARKE. U. S. Geological Survey Bulletin No. 588. Pp. 128. 1914.

This bulletin is essentially a revision, brought down to date of bulletin No. 125. It gives a more complete discussion of the silicic acids, and develops more completely than in the former edition the conception that the complex alumosilicates are best formulated as substitution derivatives of normal silicates of aluminum. F. W. C.

BOTANY.—*A conspectus of North American firs, exclusive of Mexico.* W. H. LAMB. Proceedings of the Society of American Foresters, **9**. Pp. 528–538. October, 1914.

This is a dendrological monograph on North American species of *Abies*, exclusive of Mexico, designed especially for the information of forest officers.

In our native firs, generally regarded as difficult to distinguish, each specific form is here definitely separated from its nearest relative by some anatomical difference. Those characteristics which are so variant as to be valueless as a means of identification are discarded, and the form of the cone-bract, the arrangement of the leaves, the character of the upper surface of the leaves, and the position of the resin ducts in the leaf are considered as the determinative factors so far as our native firs are concerned.

The firs, as far as they can be distinguished from foliage alone, are outlined in a key based entirely upon leaf differences, and a complete

key to North American species follows in which every distinguishing characteristic is illustrated in accompanying plate and text figures. A brief botanical description and statement of geographical distribution is given for each species. On account of the large number of trees which are mentioned in botanical literature under the name *Abies*, an index of nomenclature is included in which the name now used by the Forest Service is followed by its most commonly accepted English equivalent.

The paper is concluded with a brief bibliography. W. H. L.

ORNITHOLOGY.—*A monograph of the genus Chordeiles* Swainson, *type of a new family of goatsuckers.* HARRY C. OBERHOLSER. Bulletin of the United States National Museum, 86. Pp. viii + 123, pls. 1–6. 1914.

The genus Chordeiles is of South American origin, though at present occupying large areas in Central and North America. It has commonly been placed in the family Caprimulgidae, but its schizognathous palate and other characters, chiefly osteological, show that it should be separated as a new family, Chordeilidae. With it should be associated the genera Nannochordeiles and Nyctiprogne, also possibly Lurocalis and Podager. Incidentally, the monotypic genus Antrostomus (type, *Antrostomus carolinensis*) is, as shown by its cranial and other characters, very distinct from the Old World Caprimulgus, and also from the American whip-poor-wills, which latter should constitute a new genus Setochalcis (type, *Caprimulgus vociferus* Wilson).

The members of the genus Chordeiles are remarkable among other things for their great individual variation, amounting in some cases to distinct color phases, and to very considerable external structural differences. The genus comprises three specific groups—*Chordeiles virginianus*, *Chordeiles acutipennis*, and *Chordeiles rupestris*. The first mentioned is divisible into nine geographic races, i.e.: *C. v. virginianus*, from eastern and northwestern North America; *C. v. hesperis*, Pacific Coast and northwestern United States; *C. v. sennetti*, northern Great Plains; *C. v. howelli*, subsp. nov., central portion of western United States; *C. v. henryi*, Arizona and New Mexico; *C. v. aserriensis*, subsp. restit., southern Texas; *C. v. chapmani*, Florida and Gulf coast to eastern Texas; *C. v. vicinus*, Bahama Islands; and *C. v. minor*, Greater Antilles. Of *Chordeiles acutipennis* there are five subspecies: *C. a. acutipennis*, from central and northern South America; *C. a. exilis* (= *pruinosus* Auct.), coast of Peru and northern Chile; *C. a. micro-*

*meris*, subsp. nov., southern Mexico; *C. a. texensis*, central and northern Mexico and southwestern United States; and *C. a. inferior*, subsp. nov., Lower California. The South American *Chordeiles rupestris* has three forms: *C. r. rupestris*, from middle and northern Brazil and eastern Bolivia; *C. r. xyostictus*, subsp. nov., central Colombia; and *C. r. zaleucus*, subsp. nov., eastern and central Peru. H. C. O.

ZOOLOGY.—*Une étude philosophique de la relation entre les crinoïdes actuels et la température de leur habitat.* AUSTIN H. CLARK. Bulletin de l'Institut Océanographique, Monaco, No. 294. 1914.

Of the two suborders of recent unstalked crinoids (comatulids) one, Macrophreata, is chiefly developed in the colder waters while the other, Oligophreata, occurs chiefly in the warmer seas.

In the Macrophreata the maximum number of families is found between the temperatures of 50° and 66° Fahrenheit, from which point the number gradually decreases as the temperature becomes less, and abruptly decreases as the temperature increases; in the Oligophreata the maximum number of families is found between 60° and 65° Fahrenheit, from which point the number gradually decreases as the temperature increases, and abruptly decreases as the temperature becomes less.

Considering all the comatulid families together, the greatest representation is between 55° and 65°, with the emphasis as 60°–65°; the few families of stalked crinoids of which we have adequate knowledge also occur at these temperatures.

Thus it would appear that the temperature range between 55° and 65° Fahrenheit (12°.78 and 18°.33 Centigrade) represents the optimum temperature for the recent crinoids as a whole.

The species occurring between these temperatures represent very conservative types, all of the more aberrant types being developed in warmer or colder water. Furthermore, it is within these temperatures that the fossil crinoids find their closest living representatives. Hence it is suggested that it was possibly within these temperatures, between 55° and 65° Fahrenheit (12°.78 and 18°.33 Centigrade) that the post-palæozoic crinoid fauna was chiefly developed. A. H. C.

# INDEX TO VOLUME IV

## PROCEEDINGS, WASHINGTON ACADEMY AND AFFILIATED SOCIETIES.


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